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ABSTRACT

A second study was conducted to test further the feasibility of the proficiency module (PM) "Magnetism, Electricity, Heat, and Microscopic Viewing in Science Instruction" constructed for use in an elementary science methods course. (The first study of this PM, SP003965, demonstrated the psychological feasibility of this mode of instruction.) This second study was designed to determine statistically whether significant learning occurs through use of the PM and to further investigate student reactions including types of learning activities each selected. Pretests were administered to the sample, 20 senior women enrolled in Elementary Science Methods. Each was responsible for acquiring each performance behavior (competency) specified in the PM by selecting the learning activities or combination of activities described in the PM which would help him acquire the behavior. Learning activities identified included laboratory activities, reading, small group instruction sessions, and individual help sessions. Posttests were conducted after the 3-weeks' time allotted for the PM. Test results, analyzed using the t test for correlated data, revealed significant change in student performance. Other conclusions: Most students reacted positively to the mode of instruction. The laboratory practicum was selected as the primary learning activity. When given the opportunity, students will select different combinations of learning activities to achieve the same objectives. (JS)

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TESTING A SCIENCE EDUCATION
PROFICIENCY MODULE WITH
COLLEGE STUDENTS

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The mode of operation for the GEM program is a research and development system in which each element of the system is tested, revised, and tested and revised again during its development until it is demonstrated that the element will perform as it is intended to perform.

In the summer of 1969, a proficiency module (PM) entitled Magnetism, Electricity, Heat, and Microscopic Viewing in Science Instruction (Ricker, 1969) was constructed for use in the course, Elementary Science Methods. In the first trial of this PM data were collected to determine students' reactions to the PM, their impressions about the PM method of organizing an instructional unit, and their level of activity during the use of a PM. The results of the first trial are presented in detail in the GEM Bulletin 69-8, dated October, 1969, and entitled Reactions of College Students to a Science Education Proficiency Module, (Ricker and Hawkins).

Since the students' and teacher's reactions to the PM were positive, the psychological feasibility of this mode of instruction was considered to be demonstrated for this module. It was then decided to determine statistically whether significant learning occurs through the use of this particular science education module.

Problem

The purpose of this exploratory study was to test further the feasibility of the PM, Magnetism, Electricity, Heat, and Microscopic Viewing in Science Instruction, by conducting a second trial. The following questions were formulated:

1. Is there a statistically significant difference between student performances on a pretest administered prior to using the PM and on a post-test administered after the PM is used by the students? The null hypothesis was: There is no difference between the means of student performances on the pretest and posttest for students who participate in this instructional unit.
2. How do students react to this mode of instruction? Upon completion of the PM the students were asked to respond to the following questions:
 - a. What do you think of this means of organizing an instructional program?
 - b. How many laboratory activities contained in the laboratory handbook did you do?
 - c. How much reading did you do?
 - d. How many small group instructional sessions did you attend?

Procedure

The Sample. The group being studied consisted of 20 senior women enrolled in one section of the course ESC 339 Elementary Science Methods during the fall quarter of 1969. The students were randomly assigned to this course section so there is no reason to believe that this group of 20 students was any different than the other nine sections.

Pretesting. Each student took a pretest designed to determine if he possessed certain minimum competencies which are designated as objectives of the PM. The pretest was administered before the PM was given to the students.

Instructional Procedure. After the pretest was completed the students received the PM. Three ideas were emphasized in the explanation of the PM to the students:

- (1) Each student was responsible for acquiring each performance behavior (competency) specified in the PM if he did not already possess the performance behavior.
- (2) Each student was to select the learning activity, or combination of activities, described in the PM that would help him acquire the performance behaviors in an efficient and effective manner.
- (3) The instructor would be available to assist any student in identifying learning activities that would assist him to acquire the specified behaviors.

Various kinds of learning activities were identified and described: laboratory practicum, readings, small group sessions, and individual help sessions. Each student received a laboratory handbook that described activities that could be done in the laboratory practicum and a bibliography of readings related to the objectives of the PM.

In addition, the students received the following schedule information:

1. The laboratory schedule, or times during which the laboratory would be open with materials available for individual students or small groups.
2. The schedule for the small group instructional sessions, or times during which the instructor would be in the laboratory to work with small groups of students on problems of common concern.
3. The schedule for individual student assistance, or times during which the instructor would be available to work with individual students wishing assistance.

Posttesting. After the time allotted for the completion of the PM (3 weeks) each student took a posttest. The posttest was the same test used for the pretest. Each student was also asked to respond to the questions described earlier in the report.

Findings

The data obtained on the pretest and posttest were analyzed using the t-test for correlated data.¹ The results are indicated in Table 1.

TABLE 1

Comparison of Pretest and Posttest Means

N = 20	Pretest Mean	Posttest Mean	t value
	4.75	15.75	15.67 ^a

(a) significant at the 5% level.

The null hypothesis that there is no difference between the means of student performance on the pretest and posttest is rejected. The increase in the mean score from 4.75 on the pretest to 15.75 on the posttest is significant at the five percent level.

The data regarding the students reactions to the mode of instruction of this PM are summarized in Tables 2 through 6.

Table 2 indicates the number of students who participated in the laboratory practicum and the extent to which the students conducted the activities described in the laboratory handbook.

¹Downie, N.M. and Heath, R.W. Basic Statistical Methods. Harper and Row Publishers, 1959.

TABLE 2

Student Participation in the Laboratory Practicum

Extent to Which Activities were Completed	Number of Students
All of the activities	7
Most of the activities	12
Some of the activities	1
None of the activities	0

All twenty students selected the laboratory practicum as a learning activity in which to participate. Seven students conducted all the activities described in the lab handbook; twelve students conducted most of the activities; and one student did only some of the activities.

The data are similar to the results obtained in the first trial of the PM. In both trials there were no cases in which students did not elect to participate in the lab practicum; one student in each trial completed only some of the activities; and all the students, except one in each trial, conducted either most or all of the lab activities.

Table 3 summarized the data obtained from the students responses to the question: How much reading did you do?

TABLE 3

Amount of Reading Done by Students	
Amount of Reading	Number of Students
Much	0
Some	3
None	17

Only three, or 15 percent, of the students elected to use reading as a means of acquiring the competencies specified in the PM. None of these three students found it necessary to read extensively, however.

These data vary from the results of the first trial of the PM. In the earlier trial about 70 percent of the students utilized reading as a learning activity, whereas only 15 percent of the students in this trial read material other than the lab handbook.

Table 4 presents the number of students who attended small group instructional sessions.

TABLE 4

Student Participation in Small Group Instructional Sessions	
Number of Sessions Attended	Number of Students
Two	0
One	7
None	13

None of the students attended both of the scheduled small group instructional sessions. Seven students participated in one session. The remaining thirteen students elected not to attend any of the small group instructional sessions.

The results of the first trial vary greatly from these data. All of the students in the first trial attended at least one session, but only 35 percent of the students in this trial went to at least one small group instructional session.

There were 20 combinations of learning activities identified: one combination for each of the 20 students. Table 5 indicates the seven different combinations used by the students, and the number of students who used each combination.

TABLE 5

Combination of Learning Activities and the
Number of Students Who Utilized
Each Combination

Lab Activities Completed	Reading Done	Small Group Sessions Attended	No. of Students Who Used Combination
All	Some	None	1
All	None	None	6
Most	Some	One	1
Most	Some	None	1
Most	None	One	6
Most	None	None	4
Some	None	None	1

About 55 percent of the students used the laboratory practicum as the only learning activity; about 30 percent attended one small group instructional session and conducted most of the laboratory activities; and the remaining 15 percent had only one common characteristic -- each student elected to do some reading.

It is interesting to note that in both trials of the PM the laboratory practicum was the dominant learning activity. However, none of the students in the first trial relied solely on the laboratory practicum, whereas about 55 percent of the students in the second trial used the laboratory practicum as the only learning activity to acquire the specified competencies of the PM.

In Table 6 the students' responses to the following question are summarized: What do you think of this means of organizing an instructional program? Since the students were asked to respond freely to this question the responses of the students were categorized as being either favorable, neutral, or unfavorable for tabulation purposes.

TABLE 6

Student Responses to this Means of Organizing
an Instructional Program

Category of Response	Number of Students Responding
Favorable	19
Neutral	0
Unfavorable	1

All of the students, except one, were favorably impressed with this means of organizing an instructional program as illustrated by this particular PM.

These data are very similar to the data of the first trial. Every student, with one exception in each trial, responded to this question in a favorable way.

Conclusions

It should be recognized that definite limitations must be placed on any conclusions due to the conditions under which this exploratory study was made.

Within these limitations, however, the following conclusions seem clear:

1. Most students react positively toward the mode of instruction illustrated by the PM used in this study.

2. The laboratory practicum was selected as the primary objectives of the PM.
3. Students, when given the opportunity, will select different combinations of learning activities to achieve the same objectives
4. The use of this PM resulted in a significant change in student performance.
5. Further studies, with rigorous research designs, are needed to investigate:
 - a. possible differences in levels of achievement in connection with the different combinations of learning activities that are used,
 - b. the characteristics of the students who select the different combinations of learning activities, and
 - c. the characteristics of the students who appear to adjust to this "new" mode of instruction with little difficulty.

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